

What is claimed is:

1. A method for calculating the position of a mobile terminal, using differences between propagation distances  
5 of radio signals being transmitted and/or received on channels between base stations and a mobile terminal, said method comprising:

measuring differences between propagation distances of radio signals on channels between a plurality of base  
10 stations and a mobile terminal;

determining if the mobile terminal is located in close proximity to a base station;

calculating the position of the mobile terminal by a common formula if it is determined that said mobile terminal  
15 is not in close proximity to any of said base stations;

calculating the position of the mobile terminal in close proximity to a base station if it is determined that said mobile terminal is in close proximity to one of said base stations; and

20 outputting the position of the mobile terminal calculated.

2. The method for calculating the position of a mobile terminal as in claim 1, wherein:

determining if the mobile terminal is in close proximity to a base station further comprises:

determining whether a difference between the propagation distance on the channel between one base station out of said plurality of base stations, and the mobile terminal, and another propagation distance on the channel between another base station and the mobile terminal, falls within a predetermined tolerance for the distance between said one base station and said another base station whereby it is determined that said mobile terminal is in close proximity to the base station;

determining if the difference between the propagation distances with regard to all of said base stations does not fall within the predetermined tolerance for the distance between base stations, whereby it is determined that said mobile terminal is not in close proximity to any of said base stations.

3. The method for calculating the position of a mobile terminal as in claim 2, wherein said predetermined tolerance is corresponding to required accuracy of positioning the mobile terminal.

4. The method for calculating the position of a mobile terminal as in claim 1, wherein:

said determining if the mobile terminal is in close proximity to a base station further comprises:

measuring the quality of signals that said mobile terminal receives from said plurality of base stations,

5 comparing the received signal quality with a predetermined threshold, and

determining whether said mobile terminal is in close proximity to any of said base stations, based on the result of the comparison.

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5. The method for calculating the position of a mobile terminal as in claim 1, wherein:

said determining if the mobile terminal is in close proximity to a base station further comprises:

15 measuring the quality of signals that said mobile terminal received from said plurality of base stations,

identifying the maximum value of the measured received signal quality and the base station that transmits the signal of the maximum value,

20 comparing the maximum value of received signal quality thus identified with a predetermined threshold, and

determining whether said mobile terminal is in close proximity to any of said base stations, based on the result of the comparison.

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6. The method for calculating the position of a mobile terminal as in claim 1, wherein calculating the position of the mobile terminal in close proximity to a base station further comprises:

equating the position of the base station determined as being in close proximity to said mobile terminal with the position of said mobile terminal.

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7. The method for calculating the position of a mobile terminal as in claim 1, wherein said calculating the position of the mobile terminal in close proximity to a base station further comprises:

15 providing a plurality of point candidates where the mobile terminal may be positioned through calculation with the differences between the propagation distances obtained by said measuring the differences between the propagation distances and

20 averaging said plurality of point candidates into a point as the position of said mobile terminal.

8. A positioning system which measures reception timing of radio signals being transmitted and/or received on channels between base stations and a mobile terminal and

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calculates the position of the mobile terminal, using differences between propagation distances of the radio signals, said positioning system comprising:

receiving radio signals in a signal receiver  
5 transmitted on channels between a plurality of base stations and a mobile terminal; and

measuring the differences between propagation distances of the received radio signals in a processor,

determining if the mobile terminal is in close  
10 proximity to a base station in a determining unit;

calculating the position of the mobile terminal by a common formula if it is determined that said mobile terminal is not in close proximity to any of said base stations in a calculating unit;

15 calculating the position of the mobile terminal in close proximity to a base station if it is determined that said mobile terminal is in close proximity to one of said base stations in said calculating unit; and

outputting the position of the mobile terminal to an  
20 output terminal calculated by the common formula or calculated to be in close proximity to a base station.

9. The positioning system as recited in claim 8, wherein:

said determining unit, determining if the mobile terminal is in close proximity to a base station, also determines whether a difference between the propagation distance on the channel between one base station out of said plurality of base stations and the mobile terminal, and another propagation distance on the channel between another base station out of said plurality of base stations and the mobile terminal, falls within a predetermined tolerance for the distance between said one base station and said another base station;

wherein if the difference between the propagation distances with regard to all said base stations does not fall within the predetermined tolerance for the distance between base stations, said determining unit determines that said mobile terminal is not in close proximity to any of said base stations; and

if the difference between the propagation distances with regard to any of said base stations falls within the predetermined tolerance for the distance between base stations, said determining unit determines that said mobile terminal is in close proximity to the base station.

10. The positioning system as recited in claim 8, wherein said predetermined tolerance corresponds to a required accuracy for positioning the mobile terminal.

11. The positioning system as recited in claim 8,  
wherein:

said determining unit determining if the mobile  
5 terminal is in close proximity to a base station, also  
measures the quality of signals that said mobile terminal  
received from said plurality of base stations, and  
compares the received signal quality with a  
predetermined threshold, and  
10 determines whether said mobile terminal is in close  
proximity to any of said base stations, based on the result  
of the comparison.

12. The positioning system as recited in claim 8,  
15 wherein:

said determining unit determining if the mobile  
terminal is in close proximity to a base station, also  
measures the quality of signals that said mobile station  
received from said plurality of base stations,  
20 identifies a maximum value of the measured received  
signal quality and the base station that transmits the  
signal of the maximum value,  
compares the maximum value of received signal quality  
thus identified with a predetermined threshold, and

determines whether said mobile terminal is in close proximity to any of said base stations, based on the result of the comparison.

5           13. The positioning system as recited in claim 8, wherein:

          said determining unit determining if the mobile terminal is in close proximity to a base station, also measures the quality of signals that said plurality of base  
10   stations received from said mobile terminal,

          compares the received signal quality with a predetermined threshold, and

          determines whether said mobile terminal is in close proximity to any of said base stations, based on the result  
15   of the comparison.

          14. The positioning system as recited in claim 8, wherein:

          said determining unit for determining if the mobile  
20   terminal is in close proximity to a base station, also measures the quality of signals that said plurality of base stations received from said mobile terminal,

          identifies the maximum value of the measured received signal quality and the base station that receives the signal  
25   of the maximum value,



compares the maximum value of received signal quality thus identified with a predetermined threshold, and determines whether said mobile terminal is in close proximity to any of said base stations based on the result  
5 of the comparison.

15. The positioning system as recited in claim 8 wherein said calculating unit for calculating the position of the mobile terminal in close proximity to a base station,  
10 equates the position of the base station determined as being close to said mobile terminal with the position of said mobile terminal.

16. The positioning system as recited in claim 8,  
15 wherein said calculating unit for calculating the position of the mobile terminal in close proximity to a base station, provides a plurality of point candidates where the mobile terminal may be positioned through calculation with the differences between propagation distances obtained by  
20 said processor for measuring the differences between the propagation distances and averages said plurality of point candidates into a point as the position of said mobile terminal.

17. A position calculation apparatus which receives radio signals being transmitted/received on channels between base stations and a mobile terminal and calculates the position of the mobile terminal, using differences  
5 between propagation distances of the radio signals, said position calculation apparatus comprising:

a unit for measuring the differences between propagation distances of the signals on the channels between a plurality of base stations and a mobile terminal;

10 a second unit for determining if the mobile terminal is close to a base station, which determines whether said mobile terminal is in close proximity to any of said base stations;

a third unit for calculating the position of the  
15 mobile terminal by a common formula if it is determined that said mobile terminal is not in close proximity to any of said base stations;

wherein said third unit may also calculate the position of the mobile terminal in close proximity to a base  
20 station if it is determined that said mobile terminal is in close proximity to one of said base stations; and

an output terminal for outputting the position of the mobile terminal calculated by said third unit after calculating the mobile terminal position in close proximity  
25 to a base station, or for outputting the position of the

mobile terminal calculated by said third unit after calculating the mobile terminal position by a common formula.